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STRATA MECHANICS INSTRUMENTATION AND MONITORING PACKAGE FOR THE MONOLITHIC PACKING TRIAL ON 9E MAINGATE, LINGAN COLLIERY

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STRATA MECHANICS INSTRUMENTATION AND MONITORING PACKAGE FOR THE MONOLITHIC PACKING TRIAL ON 9E MAINGATE, LINGAN COLLIERY

by

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ABSTRACT

The implementation of a 300 m trial of 'Astrapack' monolithic cement packing at Lingan Colliery requires close monitoring to determine its efficiency.

This report presents a complete strata mechanics investigation package comprising detailed monitoring of gateroadway closure, determination of pack deformation characteristics and monitoring of pack quality, face and brushing advance, arch deformation and ambient temperatures. Details of the type, number and cost of the instrumentation required (total cost $8,598.30 per site, for a projected total of four sites for each trial).

The strata mechanics package is expected to form a part of a more general research investigation including ventilation efficiency, and cost factors.

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APPAREILLAGE ET ENSEMBLE DE SURVEILLANCE DE LA MÉCANIQUE DES STRATES POUR L'ESSAI DU REMBLAI MONOLITHIQUE SUR LA VOIE PRINCIPALE 9E DE LA HOUILLÈRE LINGAN

par

P. Cain*

RÉSUMÉ

La réalisation d'un essai à 300 m du remblai monolithique en ciment "Astrapack", à la houillère Lingan, exige une surveillance étroite à fin de déterminer l'efficacité de ce remblai.

Ce rapport présente donc un ensemble complet de recherches approfondies sur la mécanique des strates comprenant la surveillance détaillée de la fermeture de la voie de roulage, la détermination des caractéristiques de déformation du remblai et la surveillance de la qualité du remblai, de l'avancement du front de taille et de l'abattage et enfin la déformation de la voûte et les températures ambiantes. On y décrit de plus, les détails concernant la quantité et le genre d'appareillage requis ainsi que le coût (coût total 8 598,30 $ par site, avec un total projeté de quatre sites par essai).

On s'attend à ce que l'ensemble de surveillance de la mécanique des strates forme une partie d'un projet de recherche plus général comprenant l'efficacité de la ventilation et le facteur prix.

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INTRODUCTION

Difficulties in maintaining adequate faceline airflows in panels of up to 2500 m length on the East side of Lingan Colliery has prompted the decision to implement a monolithic packing trial over 300 m of the 9E maingate. Monolithic packing has been used successfully for many years in the United Kingdom to prevent gob leakage in seams prone to spontaneous combustion. The technique selected - 'Astrapack' - represents the latest in cement based packing technology, requiring substantially less material for each cubic metre of pack than previous methods.

The strata mechanics program is intended to be part of a larger monitoring scheme to determine the effectiveness of the system, including ventilation and environmental aspects. The strata mechanics investigations will determine the efficiency of the pack as a support element and will allow modification of pack design to optimise production costs.

If the implementation of 'Astrapack' is successful, its use will be continued on the 9E maingate, and a further packing trial, using the potentially less expensive Flyash/cement based 'Flashpack' will be initiated in another district. Otherwise the Flashpack trial will be in the 9E district. The extension of the program to cover these trials is also discussed.

PROPOSED PACK DESIGN

The current proposal for the installation of monolithic packing is to maintain the present face-end configuration and to replace the 1.5 m x 1.5 m hardwood chock and stonedust bag wall with a monolithic pack placed in a brattice bag supported by a mobile shutter. The pack will be approximately 2.1 m (7 ft) high and will be installed in increments of 1.2 m (4 ft). The pack width has not been decided upon. On a cost basis, a narrow pack 1.5 m (5 ft) in width is preferred, but evidence from previous monitoring in the gateroads and published data of the stress/strain characteristics of similar packs indicate that a 2.1 m (7 ft) wide pack may be more appropriate, at least until the experimental phase has been assessed and workmen have become fully trained in maintaining consistent pack quality.

PROPOSED MONITORING PROGRAM

The proposed monitoring program can be considered to consist of two parts:

Detailed Site Monitoring
Additional Monitoring

DETAILED SITE MONITORING

The proposed layout for detailed investigation sites in the trial length of gateroad is illustrated in Figure 1. The number, type and cost of the instrumentation required is tabulated in Appendix A. No costs have been derived for the drilling required, nor has the geotechnical testing of core recovered been considered in this report.

Flat Jacks: hydraulic reading mercury filled flat jacks will be placed under the main pack support elements to determine the development of pack loads.

Convergence Struts: electronic pack convergence struts will be used to monitor pack closure. In conjunction with the load cell results, this will enable in-situ stress/strain characteristics of the pack to be obtained.

Rock Bolts: conventional mechanically anchored rock bolts 0.9 m and 1.8 m in length (as indicated in Figure 12) will be used as convergence measuring stations. Differential strata movement and the development of roof beam inclination change will be inferred from this data.

Extensometers: extensometers of the Irad Gage flexible sonic probe type will be used to determine differential strata movement and the closure of bedding plane fractures above the pack. Roof and floor extensometers will be installed in cored boreholes drilled to obtain specimens for geotechnical assessment of the strata.

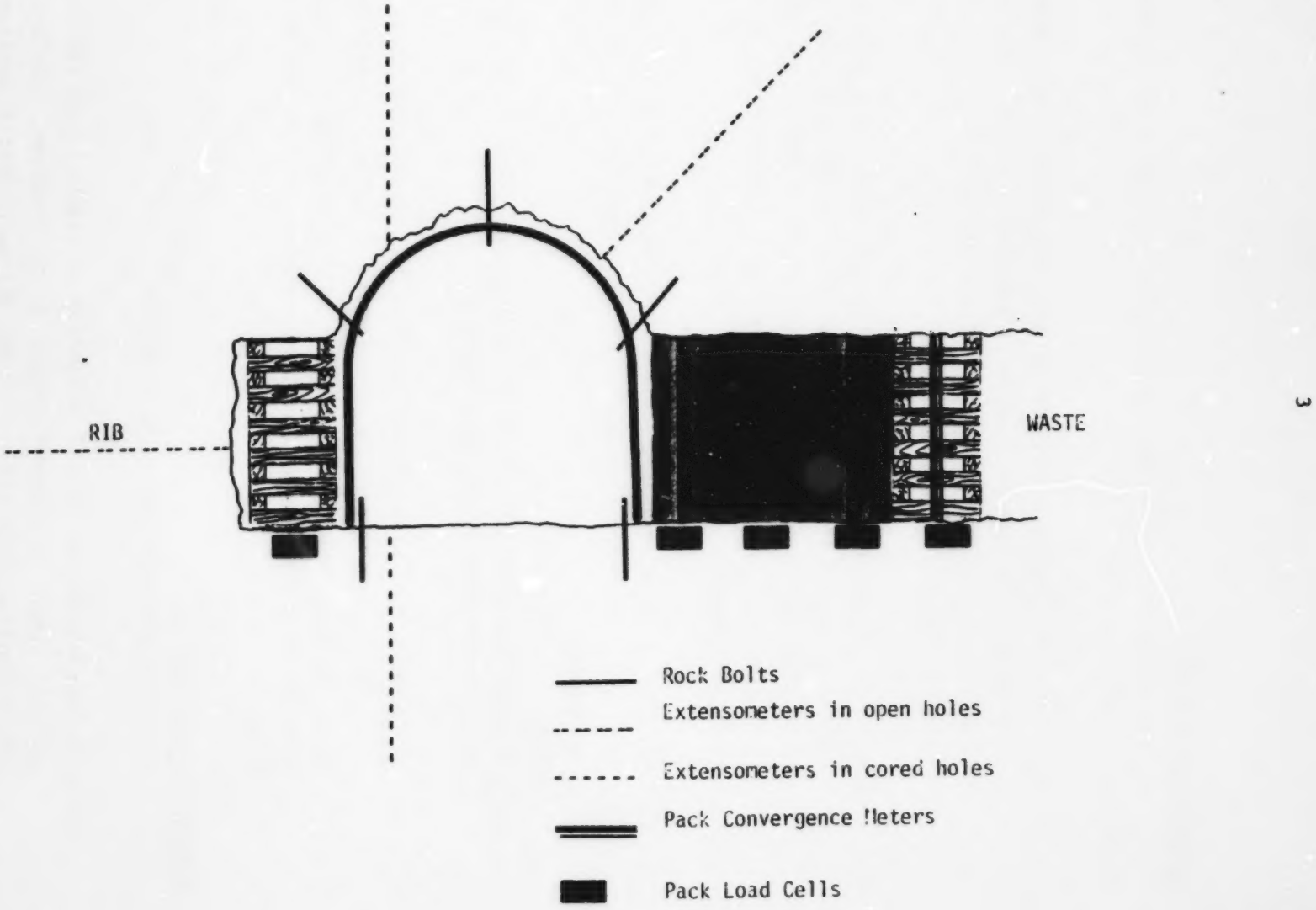

Figure 1 - Proposed instrumentation layout for detailed investigation sites

ADDITIONAL MONITORING

Five additional parameters should be monitored and recorded throughout the packing trial:

Survey Levelling: survey levelling of the rock bolts from a stable point outbye the site is required to determine relative roof and floor movement. This should be done at installation, after one month and then every two months for six months.

Pack Quality: taps on the grout, bentonite and mixing line should be installed so that grout, bentonite and final product densities can be checked and compared with optimum values. Samples of mixed packing material should be tapped off into cardboard moulds for strength testing.

Face Advance: face and brushing advance in the maingate should be monitored and recorded. Face advance rates affect the rate of pack loading.

Arch Deformation: arch deformation along the length of the trial should be monitored using photographic techniques.

Ambient Temperature: a continuous recording of ambient temperature in the packhole and, if possible, temperature of the pack constituents should be monitored. The temperature affects the rate of strength measure and could be significant during the winter months of the trial.

MONITORING FREQUENCY

Monitoring frequency should be as follows:

Detailed Site Monitoring: should be based on proximity to the faceline, and will depend on observed changes in the readings. Monitoring should continue after the initial 300 m trial. Initial monitoring will be on a shift basis, decreasing to monthly after 100 m of advance.

Additional Monitoring: pack quality should be measured for each pack installed. Pack strength samples should be collected on a regular, but not necessary shift by shift, basis. Strength samples taken should aim to cover as wide a range of installed pack properties as possible.

Face and brushing advance should be monitored on a shift by shift basis.

Arch deformation should be determined weekly for the first month, thereafter monthly. This should be continued after the initial 300 m trial to determine longterm deformation characteristics.

Ambient temperatures should be monitored on a shift by shift basis at the time of packing.

IMPLEMENTATION

The monitoring program outlined above is developed for a single site. To ensure representative results, two such sites should be installed in the trial length of gateroad. In addition, at least one instrumentation site, suitably modified to suit the different support system, should be installed in the 9E maingate prior to the implementation of the monolithic packing trial.

Site installation and maintenance could be accomplished by CBCRL staff, but assistance with monitoring will be required from suitably instructed CBDC personnel.

SUMMARY

The above monitoring program described a method of defining the strata mechanics aspects of the behaviour of a monolithic packing trial in the 9E maingate. Detailed site monitoring and additional monitoring are described as well as monitoring frequency and implementation aspects.

APPENDIX A

INSTRUMENTATION PRICE LIST

This list reflects instrumentation required to install one site as illustrated in Figure 1. All costs are FST included, FOB Sydney.

All the instrumentation, except for one pack strut per site, will be irrecoverable. (NOTE: some external fittings e.g. couplings, may be recovered after the investigation program.

It is assumed that CBCRL readout devices already on hand will be used in the monitoring process (estimated cost for purchase of the three units required is $12,000).

MATERIAL	SUPPLIER	QUANTITY	EXTENDED COST
Hydraulic Pressure Cells Model 3P1 16, 200 mm x 300 mm, 300 m transducer tube, compensation tube crumped and straightened	(1)	5	$3,500
High Pressure Nylon Tubing 6 mm O.D., 2 mm I.D., clear	(1)	1 x 100 m	150
High Pressure quick connect fittings to 1/4" weatherhead compression fittings	(1)	5	60
Extensometer Anchors for flexible sonic probe 1/2" dia, with C-clips	(1)	9	810
As above, but blanks without C-clips	(1)	27	1,350
Flexible sonic probe guide tube in 5 ft lengths	(1)	20 x 5 ft	58.30
Cor P/R Pack convergence strut 2.13 m length, 0.914 m range	(2)	3	2,670
		TOTAL	$8,598.30

SUPPLIERS

1. Solinst Canada Ltd
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